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Sheep and Goat Research Helminth Project
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Investigations on the sheep strain of *Strongyloides papillosus*

I. Observations on the effect of cortisone on the susceptibility of hamsters and guinea pigs to the sheep and rabbit strains of the threadworm

Badania nad owczym szczepem *Strongyloides papillosus*

I. Obserwacje nad wpływem kortisonu na wrażliwość chomików i świnek morskich na szczep owczy i króliczy węgora

In the course of the study on the adaptation of a sheep strain of *Strongyloides papillosus* (Wedl 1856) to various laboratory animals, attempts were made to infect rabbits, golden hamsters and guinea pigs. It was found that only rabbits could be easily infected with this parasite, but that the invasion of hamsters** and guinea pigs was not successful because of the natural resistance of these hosts to *S. papillosus*.

Several authors were able to obtain an invasion with *S. papillosus* in rabbits (Ransom 1911, Sandground 1925, 1926, Matoff 1936, Enigk 1950, Basir 1950, Timm 1954—55), but only Enigk 1950 was successful in invading hamsters, guinea pigs, and other laboratory animals (nutrias, rats and mice) with this parasite. However, the latter author could not invade hamsters, nutrias, and mice with the pig threadworm, *Strongyloides ransomi*, although Luckner 1934 stated in his experiments that infective larvae of *S. ransomi* penetrated the excised skin of guinea pigs, but he did not check whether the larvae reached the internal organs of these animals. Similar experiments were conducted by van Durne 1902 who discovered „that the infective filariform larvae of *Strongyloides stercoralis*, obtained of cultures of faeces from a chimpanzee, could penetrate intact guinea-pig skin” (cited after Goodey 1925, p. 51), but both Van Durne and Goodey do not mention anything about a successful invasion of these animals. Finally, it is worthwhile to mention that Sandground 1925 could not invade young rabbits, guinea pigs, and mice with *S. ratti*, although these animals are closely related to rats.

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** In my abstract (J. Parasitol., 46, 5, 2: 30—31, 1950) the sentence „Only two became infected” (9th line from the bottom on the page 30) should read: „Two hamsters exposed per os to 15,000 and 20,000 larvae, respectively, also failed to become infected.”

Another author who was successful in invading guinea pigs with a threadworm was Rees *et al* 1951, but he used in his experiments the infective larvae of *S. agoutii* from the agouti, which is related to the guinea pig.

The aim of the present work was to find whether two kinds of cortisone (Solu-Cortef and Predel) would be successful, and to what degree, in breaking the natural resistance of golden hamsters and guinea pigs to invasion with *S. papillosus*, and whether there is a difference in the degree of invasion between animals treated and not treated by the hormone.

The influence of cortisone on the course of invasion with nematodes other than threadworms has been studied by several authors (Coker 1955, 1956a, b, and Ritterson 1959, 1960 — on *Trichinella spiralis* in mice, or golden hamsters and Chinese hamsters, respectively; Cross 1960 — on *Nematospiroides dubius* in white rat). These authors found that cortisone breaks the natural resistance of abnormal hosts, or, in the case of animals which are not resistant to the abnormal parasite, the hormone increases their susceptibility.

Some authors believe that the normal mode of invasion with *S. papillosus* is through the oral route (Mönnig 1930), or that, when invaded perorally with *S. ransomi*, the larvae do not penetrate through the lungs (Lucker 1934, Frickers 1953). The present study was made to elucidate the problem of larval migration after oral invasion of golden hamsters.

Materials and methods

Although the writer could not find in the literature any evidences of the influence of the sex and age of abnormal laboratory animals on the susceptibility to invasion with *S. papillosus*, there are some statements that sex and age have some influence, both on the extensiveness and intensity of invasion, when abnormal hosts were invaded with other nematodes (e.g., Sheldon 1937, Todd and Hollingsworth 1952, Mathias 1954, Haley 1958a, b). Also Lewert and Lee 1954 indicate that the penetration of the skin of rats by *S. ratti* and *S. simiae* is slower in old animals, due to the thicker basement membrane of the old animals. Therefore abnormal hosts of both sexes and of different ages (1—6 months) were used in the experiments reported herein.

The larvae from sheep were cultured in 1 liter jars in the usual fecal-charcoal mixture, the rabbit feces were cultured in small (diameter 9 cm, height 1 cm) Petri dishes, because, if prepared in large containers, the surface of the medium became overgrown with mould which killed the larvae. The lid of a Petri dish was covered with a filter paper moistened every day. No difference was found in the number of larvae which were collected from the filter paper in relation to the moisture of the culture, or to the mixture of feces with charcoal. Infective larvae of the age of 7—28 days were used in the experiments, because at this age they seemed quite vigorous and viable. The surface of the Petri dish lid was washed out with water and the exact number of larvae was estimated by means of a routine dilution count. Then the larvae were placed as soon as possible on the sheared abdominal region of the experimental animal, and the penetration was considered complete after the water, in which the larvae were suspended, evaporated.

The animals were fed on balanced pelleted ration and care was taken to exclude extraneous invasion.

Golden hamsters (*Mesocricetus auratus*), guinea pigs (*Cavia porcellus*), and mixed breed rabbits (*Oryctolagus cuniculus*) were used in the experiments. Although the literature did not disclose that hamsters and guinea pigs might be the natural hosts of *S. papillosus*, routine fecal examinations were made prior to the experimental invasion. Subsequently it became evident that hamsters and guinea pigs raised at the Beltsville Parasitological Laboratory are free from threadworms; only some of the guinea pigs were harbouring small numbers of *Hymenolepis* sp. or *Coccidia*. That is why the preliminary examinations of feces were discontinued. However, all rabbits' feces were examined before the invasion, but in no case were the eggs of *Strongyloides* found. According to the literature (Hall 1916, Baylis 1936, Boughton 1932, Harkema 1936, and others) the rabbit is a normal host of *S. papillosus*.

Two kinds of adrenal corticosteroids* were used: hydrocortisone sodium succinate (Solu-Cortef), and 9-fluoroprednisolone (Predef). Both of them have a strong glucocorticoid activity, but the potency of Predef is 50 times greater than that of Solu-Cortef. The hormone was introduced intramuscularly, into muscles of the hind legs one to two days prior to invasion, or on the day of invasion. These injections were continued daily until the death of the animal, or at least for 20 days. The doses were: 0.5 mg. for hamsters, and 1.0 mg. for guinea pigs and rabbits. It was found that various daily dosages of cortisone produced no difference in their effects.

Infective larvae were given percutaneously, subcutaneously, or orally. The animals were weighed at least twice a week. The feces for the E.P.G. (number of eggs per gram of feces) count were taken from the rectum, and the eggs were counted by a flotation method, at least twice a week starting from the sixth day after infection.

Usually the necropsy was made just after the death or slaughter of animal. At necropsy, the small intestines, the lungs, the hearts, and the livers of animals were removed and placed in separate dishes with a physiological saline solution. The intestines were cut and the mucous membranes were separated by pulling the intestines twice between the fingers. After mixing, at least three aliquots were taken and the parasites counted. Lungs and livers were cut into very small pieces, hearts were opened and the blood was examined under a dissecting microscope for larvae. Adult parasites were found only in the intestine; larvae appeared in blood, lungs, and intestines.

The recovered parasites were alive and, for taking measurements, killed by heat on a glass slide. At least 20 adult parasites or larvae of different sizes were measured. Gross anatomic-pathological lesions were observed in the animals at autopsy.

The animals were divided into three groups. Group I consisted of hamsters invaded with the sheep strain of the threadworm, group II — of hamsters invaded with a rabbit strain of the parasite, and the group III consisted of guinea pigs invaded (negatively) with both the sheep and the rabbit strain of *S. papillosus*.

Results

I. Hamsters invaded with the sheep strain of *S. papillosus*

Exp. 1. 2,000 to 25,000 invasive larvae of a sheep strain of *S. papillosus* were given percutaneously to ten two-month-old golden hamsters. Two other hamsters were exposed orally to 15,000 and 20,000 larvae, respectively, and two additional hamsters received 25,000 larvae each, subcutaneously. No eggs were found in the feces starting 6 days after larval exposure, nor were larvae or adult parasites recovered from the lungs, blood, liver and intestine of animals killed 4, 9, 15, 22, and 30 days, respectively, after invasion. The

* Cortisone was supplied by the Upjohn Company, Kalamazoo, Michigan, through the courtesy of Dr. Gordon G. Stocking.

animals gained weight similarly to their controls, and no anatomic-pathological lesions were observed during necropsies.

Exp. 2. Ten 3-month-old hamsters were treated with 0.5 mg of Solu-Cortef daily, starting two days before the larval exposure. These animals were exposed percutaneously or subcutaneously, respectively, to 5,000 to 50,000 infective larvae of a sheep strain of *S. papillosus*. The animals did not become invaded, which fact was confirmed by the absence of eggs in their feces, and by the negative post-mortems undertaken 3, 7, and 14 days, respectively, after the larval exposure.

Exp. 3. Six 6-week to 2-month-old male and female hamsters (Table I), treated with 0.5 mg. of Predef daily, beginning two days prior to the infection, were exposed subcutaneously, percutaneously or orally, respectively, to 25,000 infective larvae of the sheep strain of *S. papillosus*. These animals became infected and died 20 to 66 days, respectively, after invasion. Hamster No. 5 lost 10 g. two weeks after invasion, but had regained this loss before its death 66 DAI. The number and percentage of parasites recovered at autopsy are illustrated in Table I. The three control animals in this table are numbered 7, 8, and 9.

Table I

Influence of 9-fluoroprednisolone (Predef) on the course of invasion with a sheep strain of *S. papillosus* in hamsters (0.5 mg daily)

No. of hamster	No. larvae given	Route of infect.	Strain of larvae	Died (DAI)	Number of parasites recovered						Weight (gms)	
					larvae				adults		day of infect.	at ne-cropsy
					lungs		intestine		intestine			
					No.	%	No.	%	No.	%		
1	25,000	subcut.	sheep	20	0		500	2	0		65	45
2	25,000	"	"	22	0		0		1,250	5	70	50
3	25,000	percut.	"	31	0		0		1,000	4	90	80
4	25,000	"	"	30	0		0		1,500	6	80	65
5	25,000	per os	"	66	0		0		200	1	65	65
6	25,000	"	"	54	0		0		500	2	70	65
7	0										55	70
8	0										70	80
9	0										60	75

II. Hamsters invaded with the rabbit strain of *S. papillosus*

Exp. 4. Seven 2-month-old hamsters were exposed to 25,000 infective larvae of the sheep strain of *S. papillosus*, obtained from rabbits after 3 serial passages through these animals. Three of these hamsters were exposed to the

larvae percutaneously, one subcutaneously, and three animals received the larvae orally. None of the animals became infected, nor were any parasites or anatomo-pathological lesions found in these animals, killed 2, 3, 4, 6, 8, and 23 days after invasion.

Exp. 5. Nine 2 to 6-month-old hamsters were exposed either subcutaneously, percutaneously or orally to 25,000 to 50,000 infective larvae, obtained after 5, 7, and 9 serial passages through rabbits. None of these animals became invaded.

Exp. 6. Two 2-month-old hamsters were exposed percutaneously or subcutaneously, respectively, to 25,000 infective larvae obtained from a lamb that had been previously exposed to larvae passed serially through 7 rabbits. This experiment was also negative.

Exp. 7. Eight 6-week-old hamsters, treated with 0.5 mg. of Solu-Cortef daily, starting on the day of larval exposure, were given percutaneously or orally, respectively, 25,000 larvae obtained after 1, 3, 5, and 9 serial passages through rabbits. No eggs were found in the feces, nor were the parasites recovered in the animals killed 2 to 6 weeks after invasion.

Exp. 8. Two male and two female hamsters, 2-month-old, treated with 0.5 mg. of Solu-Cortef daily, starting on the day of larval exposure, were exposed subcutaneously to 25,000 to 50,000 infective larvae, resp., of a sheep strain of *S. papillosus*, obtained after 3 serial passages through rabbits. Only the males became invaded. One male hamster, which received 25,000 larvae, was killed 7 days after invasion and a few larvae and preadult females (not gravid) of the size 1.43—1.79 mm. $\times$ 30 μ were found in the small intestine. The other male hamster, exposed to 50,000 larvae, died 21 days after invasion and about 2,000 parasitic females were found in the small intestine. The range in measurements of these parasites was: length 2.57—4.58 mm., width 64—86 μ , length of oesophagus 715—951 μ , distance between head and vulva 1790—3072 μ , anus from the posterior end of body 57—72 μ . The highest EPG (13,000) occurred on the 17th day after invasion. This animal lost 20 g. in 21 days, while the females and two control animals gained at the same time 15—25 g. No eggs were observed from either female hamster, nor were any parasites recovered from one female, killed 14 days after larval exposure.

Exp. 9. Eight 6-week-old male hamsters were treated with 0.5 mg. of Predef daily, beginning two days before the exposure of larvae. The larvae used were obtained after one or two serial passages through rabbits. Hamster No. 1 was exposed percutaneously to 50,000 larvae, No. 2 was given 50,000 larvae per os, No. 3 and 4 were injected subcutaneously with 25,000 larvae, No. 5 and 6 were exposed percutaneously to 25,000 larvae, and No. 7 and 8 received orally 25,000 larvae, respectively. All these hamsters became infected, and died 8, 10, 10, 11, 12, 13, 14, and 16 days after invasion, respectively. Three additional hamsters (numbers 9, 10, and 11) served as controls. All invaded animals lost 10—25 g., in comparison with control animals, which gained at the same time from 10 to 15 g. The number and percentage of parasites recovered at autopsy are illustrated in Table II.

Table II
Influence of 9-fluoroprednisolone (Predef) on the course of invasion with a rabbit strain of *S. papillosus* in hamsters (0.5 mg daily)

No. of hamster	No. larvae given	Route of infect.	Strain of larvae	Died (DAL)	Number of parasites recovered						Weight (gms)	
					larvae				adults		day of infect.	at necropsy
					lungs		intestine		intestine			
					No.	%	No.	%	No.	%		
1	50,000	percut.	rabb. 2	8	5,000	10	250	0.5	0		60	50
2	50,000	per os	" 2	10	0		few		1,000	2	50	35
3	25,000	subcut.	" 1	10	0		500	1	2,000	8	60	40
4	25,000	"	" 2	11	500	2	0		2,500	10	65	40
5	25,000	percut.	" 2	12	0		0		2,000	8	60	50
6	25,000	"	" 1	13	0		0		2,500	10	75	65
7	25,000	per os	" 2	14	0		0		500	2	65	50
8	25,000	"	" 1	16	0		0		500	2	80	60
9	0										55	70
10	0										70	80
11	0										60	75

III. Guinea pigs invaded with the sheep and the rabbit strain of *S. papillosus*

For comparison, also guinea pigs were invaded with the sheep and rabbit strain of *S. papillosus* without cortisone and with both kind of this hormone. The results of those experiments are given below.

Exp. 10. Four 1-month-old guinea pigs were exposed percutaneously to 15,000 to 50,000 infective larvae of a sheep strain of *S. papillosus*. Two additional animals received subcutaneously 10,000 and 25,000 larvae, respectively, of a sheep strain of threadworm. None of the animals became invaded, what was confirmed by the absence of eggs in the feces, and by the negative post-mortems. The animals gained weight similarly to their controls.

Exp. 11. Seven 2-month-old guinea pigs were injected daily with 1.0 mg. of Solu-Cortef. Two days later 5 of them were exposed percutaneously to 10,000 to 50,000 larvae of a sheep strain, and the other two guinea pigs were exposed percutaneously to 10,000 and 25,000 larvae of a rabbit strain of *S. papillosus*, respectively, after one passage through a rabbit. No eggs were found in the feces, nor were any parasites recovered from animals, killed 3, 11, and 20 days after larval exposure.

Exp. 12. Ten 1-month-old guinea pigs were treated with 1.0 mg. of Predef daily, starting 1—3 days prior to larval exposure. 25,000 to 50,000 infective larvae of a sheep strain, or of the rabbit strain of *S. papillosus*, obtained after 1 or 2 serial passages through rabbits, were given percutaneously, sub-

cutaneously, or orally. The animals did not become invaded, and the post-mortems, performed 1, 2, and 3 weeks after exposure of larvae, were negative. The animals experienced comparable weight gains to their controls.

As already mentioned, rabbits became invaded either by a sheep or a rabbit strain of *S. papillosus*. There were not found significant differences in the course of invasion of rabbits treated and not treated with Solu-Cortef. The results of experiments are given below.

Exp. 13. Twelve 1-month-old rabbits were exposed percutaneously to 5,000 to 200,000 infective larvae of a sheep strain of *S. papillosus*. All animals became invaded and eggs were found in their feces starting 10 days after invasion. The egg production apparently depended on the amount of larvae given, and in one case, that of the rabbit exposed to 200,000 larvae which died 95 DAI, the highest EPG (600,000) occurred on the 14th day after larval exposure. About 60,000 parasitic females were recovered from this rabbit at autopsy.

Exp. 14. Several rabbits were treated with 1.0 mg. of Solu-Cortef daily and exposed percutaneously to 5,000 to 200,000 infective larvae of a sheep strain of *S. papillosus*. All animals became invaded, but the worm-egg counts, the loss of weight, as well as the course of invasion did not differ significantly from that of animals not treated with cortisone.

Routes of larval migration after oral exposure of larvae

The following experiment was carried out to investigate the routes of migration of larvae after giving them orally to hamsters.

Exp. 15. Ten two-month-old male hamsters were treated with 1.0 mg of Predef daily, beginning 1 day before the larval exposure of infective larvae, which were obtained after 3 serial passages through rabbits. Four animals received 10,000 larvae each, the remaining six animals were each given 50,000 larvae.

Two animals were killed 1 day after infection, and moderate numbers of larvae were found in the blood and in the lungs. No larvae were recovered from the stomach, small intestine or the liver. Two other animals were killed 3 days after larval exposure, and some larvae were found in the lungs and in the small intestine. No differences in size between the larvae from the lungs and those from the intestine were seen. No larvae were recovered from the blood. One animal was killed 5 days after invasion, and fairly numerous larvae were found in the lungs and the small intestine. These larvae were slightly larger than those recovered from the previous animals. Two hamsters were killed 9 or 10 days after invasion, and fairly numerous preadult females were found in the small intestine. One animal, killed on the 11th day after invasion, harboured a few larvae in its lungs and about 5,000 (10% of the larvae given) adult females were recovered from the small intestine. Two remaining hamsters died on the 16th and 31st day after invasion, respectively, and only adult females were found in the small intestines. The measurements of the larvae from the lungs and the intestines, as well as adults from the intestines, taken on different days after invasion, are given in Table III.

Table III

Measurements of larvae and parasitic females in hamsters following oral exposure

Stage	Larvae						Parasitic females in intestine			
Organ	Lung's				Intestine		Preadults*	Adults		
D.A.I.	1	3	5	11	3	5	9	11	16	31
Length	500-557	522-572	536-608	536-585	572-628	590-644	2.50-3.58	2.22-3.72	3.00-3.93	3.57-4.58
Width	14-20	15-22	16-22	14-21	15-22	18-22	43-50	36-50	43-50	64-86
Length of oesophagus	200-233	215-236	210-236	210-280	236-250	215-256	915-944	715-822	751-965	715-951
Head-vulva							1640-2220	1500-2290	1927-2430	2200-2290
Anus	70-78		75-90				72-86	57-72	64-79	57-72

* The parasites recovered on the 9th day after exposure of larvae are called "preadult females" because they possessed already the external appearance of adult females but did not contain eggs.

Discussion

The only evidence in the literature that golden hamsters and guinea pigs can be artificially invaded with the sheep strain of *S. papillosus* is the report of Enigk 1950. Sandground 1925 mentions that *S. ratti* from rats was not transferable to rabbits, guinea pigs, and mice. The writer was able to infect only rabbits with *S. papillosus*, which is in agreement with many other authors (Ransom 1907, Sandground 1926, Basir 1950, Enigk 1950, Timm 1954-55).

The fact that the writer was not successful in infecting untreated golden hamsters and guinea pigs with the sheep strain of *S. papillosus*, or with a strain of this parasite obtained after 3, 5, 7, and 9 serial passages through rabbits, is peculiar and very difficult to explain in the light of Enigk's 1950 work. Perhaps there is a difference in the infectivity of the European and the American strains of *S. papillosus*, similar to the difference of the mode of the development between the European and the American strains of *S. ransomi* from pigs. Tarczyński 1956 and other European authors state that *S. ransomi* in Europe does not have the indirect mode of development. Another reason may be that the laboratory animals raised at the Beltsville Parasitological Laboratory are more resistant to invasion with *S. papillosus* than the animals used by Enigk. Therefore, the writer intends to undertake further attempts to infect hamsters and guinea pigs with the European form of the sheep strain of *S. papillosus*.

The influence of cortisone on the course of invasion of hamsters, guinea pigs and rabbits with the sheep strain and the rabbit strain of *S. papillosus*

(as well as on the representatives of the genus *Strongyloides* itself) was studied for the first time. The present study confirms the statements of Coker 1955, 1956a, and Ritterson 1959 that the various daily dosages of this hormone produce no differences in their effects, and that there are not any differences if the hormone is introduced to the animals 1 or 2 days before, or on the day of the larval exposure. However, contrary to the statement of Cross 1960, who did not find any differences in the effectiveness of two kinds of cortisone (hydrocortisone and cortisone acetate) on the course of invasion in the white rat of the mouse species, *Nematospiroides dubius* — the writer was able to demonstrate that hydrocortisone sodium succinate (Solu-Cortef) was much less effective on the course of invasion in golden hamsters with *S. papillosus*, than 9-fluoroprednisolone acetate (Predef). The differences in the effectiveness of the two kinds of cortisones used are shown by the fact that Solu-Cortef was not able to lower the natural resistance of guinea pigs, when the larvae were introduced either percutaneously, subcutaneously, or even when for the percutaneous exposure a rabbit strain of larvae was used. Solu-Cortef was able to lower the natural resistance against *S. papillosus* in male hamsters, but only when the rabbit strain (three serial passages through rabbits) of *S. papillosus* was used and only when the infective larvae were exposed subcutaneously. On the contrary, Predef was effective in breaking the natural resistance of golden hamsters when the infective larvae of either a sheep strain or a rabbit strain (one or two serial passages through rabbits) of *S. papillosus* was introduced percutaneously, subcutaneously, or orally. The virulence of the rabbit strain apparently was greater than that of the sheep strain. But again, Predef was not effective in breaking the natural resistance of guinea pigs to the infection, when the sheep or the rabbit strain (one or two serial passages through rabbits) of *S. papillosus* was introduced percutaneously, subcutaneously, or orally.

The course of the invasion in rabbits, treated and not treated with Solu-Cortef, did not indicate significant differences in pathogenicity, E.P.G. production, anatomo-pathological lesions, and loss of weight.

No differences in the path of the larval migration were found if the infective larvae were exposed to Predef-treated hamsters percutaneously, subcutaneously, or orally. However, the severity of the disease depended on at least four factors: the kind of cortisone used, the number of larvae given, the method by which the larvae were given, and the strain of larvae used.

(1) Hamsters died of the invasion sooner if Predef was used. (2) 50,000 infective larvae of the rabbit strain killed hamsters 8 to 10 days after invasion, and 25,000 larvae killed them 10 to 16 days after invasion. (3) The animals died sooner if the same dose of larvae was given subcutaneously (10—11 DAI rabbit strain, 20—22 DAI sheep strain), than percutaneously (12—13 DAI rabbit strain, 30—31 DAI sheep strain), or orally (14—16 DAI rabbit strain, 54—66 DAI sheep strain). (4) 25,000 larvae of the rabbit strain of *S. papillosus*, obtained after 1 or 2 serial passages through rabbits, killed the hamsters 10 to 16 days after invasion; the same dose of the larvae of a sheep strain of the nematode killed the animals 20—66 days after larval exposure (Table I and II).

Also the percentage of the parasites recovered at autopsy depended on various factors. A higher percentage of the parasites recovered was found in

animals exposed subcutaneously (9—12%), than percutaneously (8 to 10.5%), or orally (2%). The percentage was also higher in hamsters exposed to the rabbit strain of the parasite (2 to 12%) than in animals invaded with the sheep strain of *S. papillosus* (1 to 6%, Table I and II).

When exposed orally, the migration of the larvae in the body of hamsters was similar to that when the animals were exposed percutaneously or subcutaneously, i. e., the larvae entered the blood vessels of the upper part of the intestinal tract, penetrated the lungs and then migrated to the small intestine. Larvae were recovered from the blood only on the second day after invasion, and from the lungs 1 to 11 days after exposure to the larvae. However, the adult females were recovered only on the 11th day after invasion, whereas in the animals exposed percutaneously or subcutaneously adult females were found on the 8th day after invasion. No larvae were found in the intestine until the 3rd day after oral exposure to larvae.

The above findings are in agreement with the works of Faust et al. 1934, Faust 1935, and Matoff 1936, but contrary to the statements of Mönig 1930, Lucker 1934, and Frickers 1953 who were of the opinion that, when given orally, the larvae do not pass through the lungs.

Limited data on the influence of sex and age on the susceptibility of the laboratory animals to invasion with *S. papillosus* show that — at least when treated with Solu-Cortef and exposed subcutaneously to the infective larvae of the parasite — only male hamsters became invaded, but no significant influence of age of hamsters and rabbits was found.

The anatomo-pathological lesions in hamsters are similar to those described by Enigk 1952b, Turner 1959, Turner et al. 1960, and other authors: dermatitis, petechiae and ecchymoses in the lungs, and enteritis. Also anemia, abnormal stools, a fluid exudate in the small intestine, and loss of weight were observed.

The prepatent period in cortisone treated hamsters was 11 days, in untreated rabbits it lasted 10 days, and in cortisone treated rabbits also 10 days. This differs a little from the prepatent period in sheep and goats, which is, according to Turner 1959 and the writer, 9 days.

SUMMARY

1. Golden hamsters did not become invaded with a sheep strain or a rabbit strain (1, 3, 5, 7, and 9 passages through rabbits) of *S. papillosus* after percutaneous, subcutaneous, or oral exposure to infective larvae. Solu-Cortef did not break the natural resistance of hamsters to either the larvae of a sheep strain or of a rabbit strain (after 1, 3, 5, and 9 passages through rabbits) of *S. papillosus* which were exposed percutaneously. Infection first occurred in male hamsters treated with Solu-Cortef when the infective larvae were exposed subcutaneously and a rabbit strain (3 serial passages through rabbits) was used. Similarly treated females did not become invaded. Prednisolone broke the natural resistance of male hamsters to the sheep strain and the rabbit strain (1 or 2 passages through these animals) of *S. papillosus* after percutaneous, subcutaneous, or oral exposure of infective larvae. The rabbit strain was more virulent than the sheep strain, and the subcutaneous exposure of the larvae was more effective than the percutaneous or oral routes.

2. Guinea pigs did not become invaded with a sheep or a rabbit strain of *S. papillosus* after percutaneous, subcutaneous, or oral exposure to infective larvae. The invasion in guinea pigs did not ever occur if both kinds of cortisone (Solu-Cortef and Predef) were used, and both the sheep and the rabbit strain of a parasite was given subcutaneously, percutaneously, or orally.

3. Rabbits became invaded with a sheep strain of threadworm. The lethal dose was 200,000 larvae exposed percutaneously. The highest EPG (600,000) production occurred on the 14th day after invasion. The prepatent period was 10 days. The picture of the invasion of rabbits treated with Solu-Cortef was similar.

4. The migration of the larvae in the body of hamsters, treated with Predef after oral exposure was similar to that when the larvae were introduced percutaneously or subcutaneously.

5. Male hamsters were more susceptible to the invasion than females. No significant differences were found in susceptibility of hamsters and rabbits of different age.

6. Various daily dosages of either Solu-Cortef and Predef produce no difference in their effects on the pathogenicity of strongyloidiasis in hamsters and rabbits.

7. No parasitic males were found in hamsters and rabbits, and the parasitic females were recovered only from the intestines of animals.

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STRESZCZENIE

W czasie badań nad adaptacją owczego szczepu *Strongyloides papillosus* do zwierząt laboratoryjnych, autor przeprowadzał próby zarażenia królików, złotych chomików i świnek morskich. Jedynie króliki uległy zarażeniu, natomiast chomiki i świnki morskie, którym podano naskórną, podskórną lub doustnie inwazyjne larwy szczepu owczego lub szczepu, który został przepasażowany przez 1, 3, 5, 7 i 9 pokoleń królików, nie uległy zarażeniu.

Wobec tego, w celu przełamania odporności wrodzonej chomików i świnek morskich, zastosowano 2 rodzaje kortisonu (hydrocortisone sodium succinate = Solu-Cortef i 9-fluoroprednisolone acetate = Predef), podawanego zwierzętom w ilości 0,5 lub 1,0 mg dziennie. Hormon wstrzykiwano podskórną, poczynając 2 dni lub 1 dzień przed zarażaniem, względnie w dniu zarażania, do dnia śmierci zwierząt, lub przynajmniej w ciągu 20 dni. Niniejsza praca jest pierwszym doniesieniem na temat wpływu kortisonu na zarażenie zwierząt laboratoryjnych węgorzami.

Stwierdzono, że ani Solu-Cortef ani Predef nie zdołały przełamać wrodzonej odporności świnek morskich na zarażenie szczepem owczym lub nawet szczepem króliczym (szczep owczy, przepasażowany przez kilka pokoleń królików) *S. papillosus* tak drogą naskórną, jak i podskórną lub doustną.

Solu-Cortef zdołał przełamać wrodzoną odporność samców chomików, ale jedynie w tym przypadku, gdy do zarażenia użyto szczepu, przepasażowanego przez króliki i podanego drogą podskórną. Natomiast samce chomików, traktowane powyższym hormonem, którym podano owczy lub króliczy szczep drogą naskórną lub doustną, nie uległy zarażeniu. Jeszcze bardziej odporne okazały się samice, które nie uległy zarażeniu po zastosowaniu szczepu owczego lub króliczego tak drogą naskórną i doustną, jak i podskórną.

Predef zdołał przełamać odporność chomików po podaniu inwazyjnych larw szczepu owczego i szczepu króliczego, zarówno drogą naskórną, jak i doustną i podskórną. Szczep króliczy był bardziej wirulentny w stosunku do chomików od szczepu owczego, a śmierć zwierząt następowała szybciej po podaniu larw drogą podskórną, aniżeli naskórną lub doustną (tab. I i II).

Nasilenie schorzenia u chomików zależało od kilku czynników: (1) rodzaju kortisonu, (2) liczby podanych larw, (3) sposobu podania larw, oraz (4) szczepu węgorza.

Drogi migracji larw w ciele chomików (traktowanych kortisonem) po podaniu inwazyjnych larw drogą doustną były takie same, jak po podaniu naskórnym lub podskórnym: larwy przenikały do naczyń krwionośnych górnego odcinka przewodu pokarmowego, wędrowały do płuc, a stąd dostawały się do jelita. Larwy stwierdzono we krwi jedynie do ok. 24 godz. po zarażeniu, a w płucach 1—11 dni po zarażeniu; w jelicie pierwsze larwy pojawiły się dopiero w 4 dni po zarażeniu. Natomiast dojrzałe samice zostały stwierdzone w jelicie dopiero 11 dnia od chwili zarażenia.